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A Study of the Glacial Geology & Water Bearing Strata of the Urbana, Illinois Quadrangle

Geology

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A STUDY OF THE GLACIAL GEOLOGY

AND

WATER BEARING STRATA

OF THE

URBANA, ILLINOIS QUADRANGLE

BY

CLARENCE SAMUEL ROSS

THESIS

FOR THE

DEGREE OF BACHELOR OF ARTS

IN

GEOLOGY

COLLEGE OF SCIENCE

UNIVERSITY OF ILLINOIS

1913

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June 4, 1913

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

CLARENCE SAMUEL ROSS

ENTITLED A STUDY OF THE GLACIAL GEOLOGY

AND WATER BEARING STRATA OF THE URBANA, ILLINOIS QUADRANGLE

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF BACHELOR OF ARTS

IN GENERAL SCIENCE

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247446

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A STUDY OF THE GLACIAL GEOLOGY, AND WATER BEARING STRATA OF THE URBANA, ILLINOIS QUADRANGLE.

I N T R O D U C T I O N

Location and Area.

The Urbana, Illinois quadrangle is included between parallels 40°00' and 40°15' north latitude, and meridians 88°00' and 88°15' west longitude. It covers an area of about 225 square miles, being 13.15 miles from east to west and 17.15 miles from north to south. It is situated about 226 miles south of Chicago, and Urbana, near its western border, is about 32 miles west of the Indiana-Illinois state line. This locates the Urbana quadrangle near the east side of the state about midway of its length north and south. Urbana and Champaign which are near together not far from the west border of the area are about equally distant from its northern and southern bounderies.

Topography

The most noticeable feature of the topography is the extreme levelness of the greater portion of its surface. This is best seen southeast of Flatville, but nearly as well south of Mayview; in fact any portion outside of the moriane and away from the larger streams is very flat.

The quadrangle is crossed by the recessional moraines of the Champaign lobe of the early Wisconsin glaciation, the course of which will be described later. The greatest height of the morainal ridges is about 70 feet above the level of the plain and the average elevation is about 50 feet. The period of time that has elapsed since the final withdrawl of the latest or Wisconsin ice sheet is so short geologically speaking that the topography of the surface of the drift which is left is very young. Drainage is ineffective and stream erosion has modified the topography but little. Where Salt Fork cuts through the morainal ridge near Augerville a channel with bluffs 40 feet high has been produced. Just east of this on the level ground morianes the channel is hardly noticeable. Between St. Joseph and the point at which this stream leaves the quadrangle a channel with bluffs about 35 feet high has been cut in the nearly level plain.

Relief. - The average elevation of the surface is about 700 feet above sea level and the greatest difference of elevation is about 150 feet. The highest point is near the northeast corner of the quadrangle where the altitude is about 785 feet. A point on Yankee Ridge, about half way between Urbana and Philo is nearly as high, reaching above 770 feet. The lowest point is where the channel of Salt Fork leaves the area, about $3\frac{1}{2}$ miles north of the southeast corner, which is about 635 feet above sea level.

Drainage. - Since this region is near the beginning of the erosion cycle its drainage is very imperfect. Large areas have been made available for farming only by extensive ditching.

Salt Fork, the largest stream in the quadrangle, rises near Thomasboro in the northern part of the area. It follows a general southward direction to Urbana, thence it swings east to St. Joseph, whence it turns south to Sidney, and then it swings to the northeast to where it crosses the eastern boundry of the area about 3½ miles north of the southeast corner of the quadrangle. In the northern part of the area, near Thomasboro, the source of this stream is a series of drainage ditches.

The stream next in importance in this area is Spoon River which rises near the northeast part of the quadrangle, and flows nearly south to the Salt Fork which it joins near the town of St. Joseph.

The head waters of the Embarras River are formed by the small streams that drain the west and south slopes of the moraine south of Urbana. This river flows nearly south to the south border of the quadrangle, and continues in a general southward direction as far as Newton in Jasper County, whence it swings towards the southeast and joins the Wabash near Lawrenceville.

PREPLEISTOCENE DEPOSITS

General Statement

Throughout Paleozoic time this area in common with the rest of the Mississippi valley was alternately an area of marine sedimentation, and of land erosion. The last great period of sedimentation is represented by the Pennsylvanian system of rocks, and the final elevation above the sea occurred near the end of that period. The ensuing period of erosion was very long lasting. throughout all of the Mesozoic and most of the Cenozoic Eras.

Previous to the Pleistocene period the surface of Illinois came to have a topography more rugged that that of the present. In this part of the state there was developed a general relief comparable to that of the southern Illinois at the present time. Profound as was this erosion it did not remove all of the sediments of the Pennsylvanian system, a thickness of 400 to 600 feet of these rocks remaining above the Mississippian. Pennsylvanian rocks are nowhere exposed in this area, being covered by from 100 to 300 feet of drift, however the bed of rock of the quadrangle is everywhere of Pennsylvanian age.

THE PRE-GLACIAL ROCK SURFACE OF THE REGION

It is evident from the great difference in the elevation of the surface of the bed rock in different parts of the area that the greater part of this quadrangle must have been the site of a wide pre-glacial valley that has been filled by the glacial drift. Water is usually found in sufficient quantities in porous beds within the drift, so that few wells penetrate to the bed rocks. Thus the exact limits and extent of this pre-glacial valley are difficult to ascertain, however it must have been very extensive. The lowest point at which bed rock is reached in this quadrangle is near the center, about one mile south of Mt. Olivet. Here rock was reached at an altitude of 403 feet above sea level. At Thomasboro the elevation of the rock floor is 436 feet. Several different wells in Urbana and Champaign strike rock at about 440 feet above sea level. Three miles north of the eastern limits of Urbana, rock was not encountered at an elevation of 442 feet

above sea level and one mile north of Philo rock lies below an elevation of 474 feet. All these wells are evidently in a valley that was some 160 feet below the upland region that lies a short distance further east. At Sidney rock is encountered at 565 feet and at Homer, about five miles east of Sidney, the elevation of rock is about the same.

A plotting of unpublished well records from the office of the Illinois Geological survey, and also some of those given in Leveretts "Illinois Glacial Lobe", Monograph XXXVIII U. S. G. S. give some idea of the depth and extent of the great pre-glacial valley of this region. At Monticello the county seat of Piatt County the elevation of the rock floor is about 343 feet, at Clinton the county-seat of DeWitt County it is 400 feet. Very few wells penetrate through the drift in McLean County, but at the southern limits of the City of Bloomington rock is encountered at 470 feet above sea level. Not far north of this point coal shafts reach bed rock at 667 feet. At Heyworth in the southern part of the county the elevation of rock is 447 feet. At Mansfield in northern Piatt County, the elevation is 496 feet. At Delavan, in Tazewell County, rock is reported at an altitude of 288 feet and at Pekin it is 280 feet.

South of the quadrangle in the vicinity of Mattoon the drift is not more than 100 feet thick and rock is found at an elevation of 625 feet above sea level. East of the quadrangle there must have existed an old pre-glacial upland as shown by the rocks outcroping on lower Salt Fork and on the Vermilion River in Vermilion County, at an elevation considerably above the rock surface over the greater part of our area. North of

this area rock outcrops are common along most of the course of the Kankakee River from Momence west. These facts seem to indicate that there was present in this part of the state an extensive pre-glacial stream or more probably a stream system with numerous branches. Many buried valleyes are reported in Livingston County seperated by uplands some 200 feet higher than the valley bottoms. The elevation of the rock surface at Paxton, the county seat of Ford County, is given at 343 feet and at Onarga in Iroquois County at 360 feet above sea level. In the northern part of Virmilion County rock is found at 465 feet above sea level. It is thus probable that a valley extended from the pre-glacial Illinois river in a more or less easterly direction to about the eastern boundary of the state, with this main valley numerous tributary valleys were connected. Well records seem to show that the river system in east central Illinois may have been tributary to the river that occupied the present Illinois river valley in pre-glacial time. In fact drainage in any other direction is almost imposssible. The level of the present Illinois river has an altitude many feet above some of the rock surface elevations given above, but it is known that below the great bend of the Illinois River near Hennepin that river flows in a valley that has been silted up 100 or more feet above its level in pre-glacial times, then the pre-glacial Illinois river valley was sufficiently low to enable it to drain such a valley in eastern Illinois as the one that has just been described.

PLEISTOCENE DEPOSITS

The Illinois Glacial Stage

The third great ice sheet that covered portions of the continent in Pleistocene times is called the Illinoian and this is the first continental glacier that is known certainly to have covered this portion of Illinois. The center of accumulation of this ice sheet was in the Labrador region and from this center the Illinoian ice sheet moved south and west over southwest Canada and the northern part of the United States, almost to the southern and western limits of Illinois. As the ice sheet passed over this part of the state it was heavily loaded with material gathered in its course from the northeast. This debris was deposited in the form of till or drift, the surface of which was nearly level. The thickness was especially great over such pre-glacial valleys as the one occupying the greater portion of this quadrangle, reaching as much as 200 feet.

If the peat horizon is taken as the level of the Illinoian inter-glacial surface, the thickness of the Illinoian till sheet is about 190 feet at Champaign and Urbana; and in the vicinity of Philo it is 190 or 200 feet thick. In the eastern part of the quadrangle above the pre-glacial upland the thickness is much less being from 30 to 45 feet.

THE SAND BEDS ASSOCIATED WITH THE ILLINOIAN DRIFT.

The upper part of the Illinoian drift surface is remarkable for the great extent and uniformity of elevation of the

sand and gravel beds that furnish nearly the whole water supply of the area. Two of these water bearing beds associated with the Illinoian drift are encountered in so many wells that it has been possible to plot their contours in a very approximate manner as described on a later page, under "Water Supply". The sand horizons were probably formed near the close of the Illinoian glacial stage, and must have been produced by the recession of the ice and the deposition of beds of sand along the stream channels by the water liberated by the melting ice. After the deposition of these water-laid sand beds, a re-advance of the ice buried the sand beneath a bed of drift. A second recession of the ice permitted the deposition of another sand bed upon the surface of the later drift. The upper part of these sand horizons is usually made up of very fine, light gray sand. At lower levels the material tends to become coarser, but well drillers cannot be certain of striking gravel at any constant horizon as the material seems to change from fine to coarse at the same level within a few rods. The Illinoian drift seems to be much more sandy in its composition than the succeeding Wisconsin till sheet which is a rather dense pebbly clay.

THE SANGAMON INTERGLACIAL EPOCH

As the ice of the Illinoian glacier withdrew from the region, wind and water reworked the surface of this drift sheet the upper portion of which was gradually oxidized by the atmosphere and plants at last slowly became established on its surface. The period following the Illinoian glaciation is called the Sangamon interglacial epoch , but since the Iowan glaciation

did not reach as far south as this part of the state the time represented by the Sangamon interglacial epoch, the Iowan glacial epoch and the succeeding Peorian interglacial epoch intervened between the Illinoian and Wisconsin epochs of glaciation. Only a rough estimate can be made as to the length of time represented by these epoches, but the difference in the degree of erosion seen on the exposed surfaces of the Illinoian and the Wisconsin drift sheets respectively, show that the time was very long. The oxidation of the soils that were formed at this time also give similar evidence of a long lapse of time. It is probable that the pre-glacial topography was so throughly obliterated by the deposits of the Illinoian and Wisconsin glaciers that an entirely new post glacial drainage system was developed on the new land surface.

From the fact that conditions were favorable for the development of extensive peat beds, and that such species of conifer as Picea alba have been identified from the Sangamon soil horizon it seems certain that the climate must have been moderately cool and moist. It is however probable that the conditions recorded by such vegetation, were those near the close of the inter-glacial period, a short time before the approach of the Wisconsin glacial conditions.

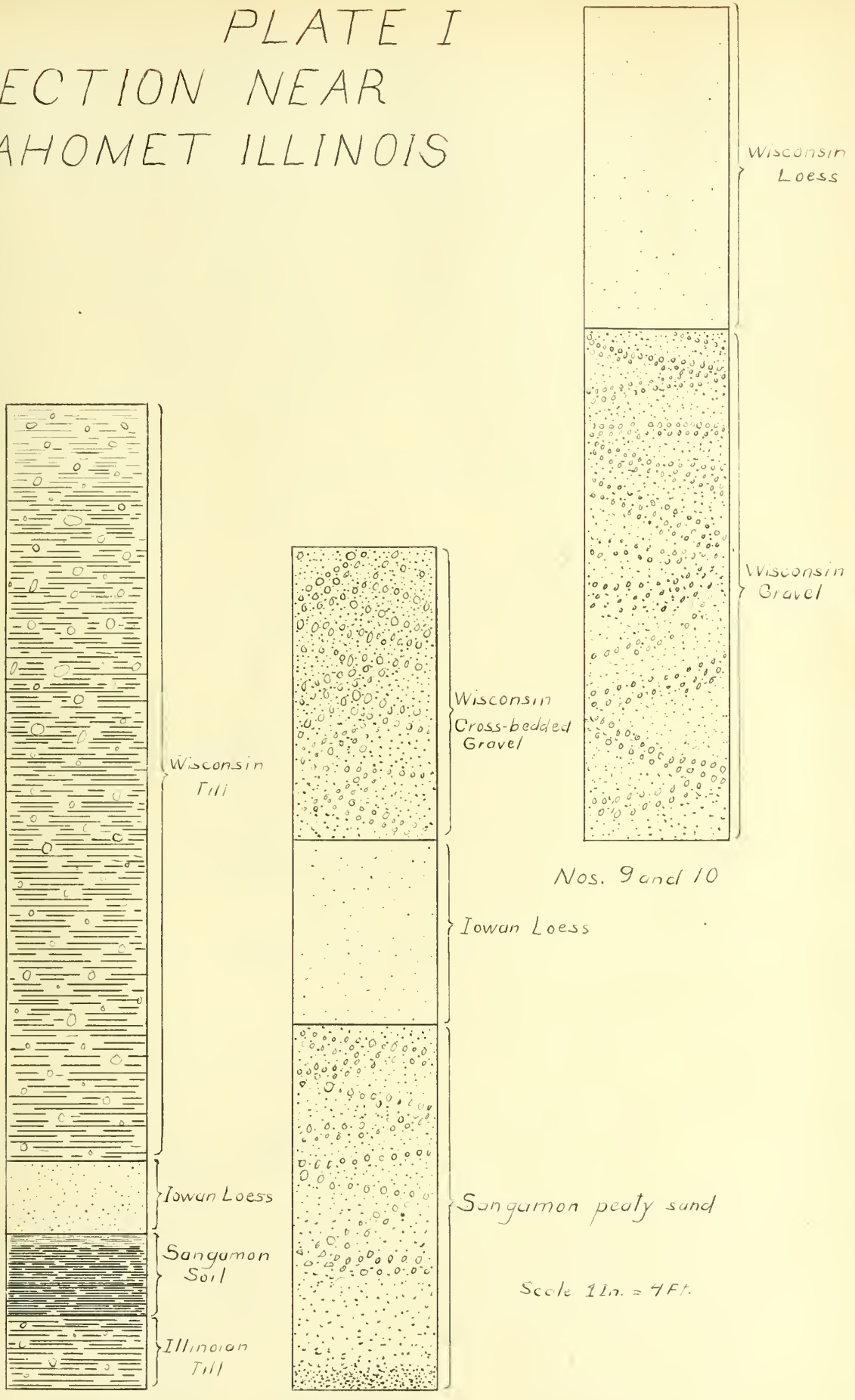
A shaft put down in Champaign in prospecting for coal encountered two feet of peat and a log of wood identified as Picea alba or a very close relative, at an elevation of about 610 feet. A boring made in Urbana in 1884 about one-half mile east of the Cleveland, Cincinnati, Chicago and St. Louis Railway round house passed through two feet of peaty soil as reported

by Professor C. W. Rolfe, at a depth of 78 feet, or at about the same elevation as that of the first peat bed mentioned. In a well put down on the campus of the University of Illinis, a peaty soil layer was encountered at a depth of 71 to 74 feet. Six and one-half miles south of Urbana black muck and a log of wood resembling pine, were encountered in a well at an elevation of 640 feet. Near Philo an interglacial soil zone containing fragments of wood having a dark charred appearance was reached at an elevation of 630 feet. In the vicinity of Tipton a layer eight inches to two feet thick, locally called coal, has been reported from between 70 and 80 wells at the nearly uniform elevation of 610 feet. From the examination of fragments of this so-called coal it seems to represent the residual vegetable material of an interglacial swamp. One mile west and three miles north of St. Joseph carbonaceous material mixed with fragments of nearly undecayed wood were encountered in wells at a similar elevation, and two miles east of the latter place the carbonaceous material is again found at an elevation of 620 feet. These records are not so complete as could be desired, but they locate very definitely the interglacial soil surface. In the western part of the quadrangle the elevation of this old surface is about 640 feet above sea level. It has a general slope eastward, so that in the east part of the quadrangle it has an elevation of 610 feet.

Within the Urbana quadrangle the Sangamon inter-glacial soil is everywhere covered by the deposits of the Wisconsin ice sheet. Along the Sangamon River one and one half miles southwest of Mahomet, ten miles west of Champaign, there is exposed an excellent section extending from the top of the loess above the Wisconsin

PLATE I

SECTION NEAR MAHOMET ILLINOIS



drift down about 60 feet into the Illinoian till. At this place an interglacial soil horizon is unusually well developed at an altitude of about 760 feet, in places lying within a few feet of the surface. This exposure gives the best information of the character and succession of glacial and interglacial deposits of any known outcrop in this region. The complete section is not found in any single place, but exposures of the different horizons are not far apart and their correlation is not at all difficult. The following composite section will show the succession of these deposits.

Section of strata exposed along the Sangamon River near Mahomet.

9 and 10. Exposed in the gravel pit three-fourths of a mile northwest of the bridge across the Sangamon River

10. Loess, yellowish-brown in color free from pebbles, overlying sand and gravel of Wisconsin age - - - - - 9 Ft.

9. Sand and gravel, beautifully crossbedded - - - - 14 Ft.

5 to 8. Exposed in the river bluff one-fourth mile east of the gravel pit.

8. Corssbedded sand and gravel - - - - - - - - - - - -- 8 Ft.

7. Grayish-brown Iowan loess, in places sandy, and very calcareous. The contact of this loess with the sand and gravel above is clearly exposed - - - - - - -- 5 Ft.

6. Zone of mixed sand and loess rather firmly cemented - - 1-3 in.

5. Sand, upper part crossbedded, lower part with much vegetable matter. At the contact with the loess the two are intermingled through a thickness of one foot - - - - - - - 10 Ft.

1 to 4. Exposed in the river bank one mile northwest of the bridge.

4. Grayish brown, pebbly Wisconsin till - - - - - - - - - - 20 Ft.

3. Grayish brown Iowan loess, contact with till above covered by talus - 2 Ft.

2. Black soil, composed of very fine sand with vegetable matter. A transition from soil to loess in the upper 6 inches (Sangamon Interglacial deposit) - - - - 2 Ft.

1. Grayish-brown Illinoian till - - - - - - - - - - - - - 3 Ft.

The difference between the loess on the Wisconsin drift and that over the Illinoian illustrates probable important differences in the modes of loess deposition. The loess upon the Wisconsin drift though much younger is much more soil like in character than that of the Iowan loess overlying the Illinoian till, which latter is largely composed of pulverized rock material but little changed by the process of weathering. The color of the older loess is also much lighter and the constituent particles are more angular and larger in size than in the younger deposit. Parts of the Iowan loess show very fine stratification lines while the loess overlying the Wisconsin drift is too much weathered for such lines to be preserved if

they were ever present. While the conditions of exposure of the two deposits is very similar there is no evidence of deposition of calcium carbonate concretions within or at the base of the loess above the Wisconsin drift, while at the base of the Iowan loess, concretions are common and are probably still being formed. The upper part of the sand underlying the Iowan loess is in places firmly cemented with calcium carbonate deposited from percolating water.

In the bluffs where the loess is found, peat is not developed but the basal portion of the sand contains a large amount of vegetable matter, and this horizon clearly corresponds stratigraphically to the soil bed found in the river bank one half mile further northwest. At the latter point there can be no doubt of the development of the Sangamon soil horizon, for here the black soil occurs between two till sheets; and with the typical Iowan loess just above the black soil. The contact between the Iowan loess and the Wisconsin till is covered by talus from the overlying till, but the contact between the soil and the Illinoian till below is well exposed and clear cut. In the upper part of the soil horizon there is a transition from a black soil with a very large proportion of vegetable matter to the typical Iowan loess, and indeed loess like material forms the greater part of the mineral elements of the soil itself. It contains no coarse material of any kind and only very fine angular sand. Fine lines of

stratification are common, and especially noticeable in the upper part where dark bands full of vegetable matter alternate with layers of loess. It is difficult to decide whether this lamination was due to water or wind deposition, but the whole deposit seems more like a true soil than the beds that would be deposited by water. Just below the loess in the upper part of the soil horizon, are found many fragments of wood varying in size from twigs up to pieces several inches in diameter. The wood fragments have not been critically studied as yet and oak is the only kind certainly recognized. In the layers below that containing most of the wood fragments there were found the wing covers of several beetles and other insects. The organisms in the peat and soil bed seem to indicate climatal conditions during the formation of the Sangamon interglacial deposit not greatly different from the present.

THE EARLY WISCONSIN GLACIAL STAGE

The greatest extension of the Wisconsin ice sheet is marked by the Shelbyville terminal moraine which passes near the cities of Pekin, Clinton, Decatur, Shelbyville, Mattoon and Paris. As this ice sheet withdrew to the north it made several long pauses during which recessional moraines were formed around the border of the ice front. Leverett believes, however, that after its greatest advance the ice withdrew an indefinite distance to the north and then re-advanced forming true terminal moraines at

successive intervals, but no evidence in support of this view has been found.

The Recessional Moraines of the Wisconsin Glacial Stage.

The first moraine formed as the ice sheet paused in its withdrawal towards the north takes its name from the city of Champaign which is situated upon its border. The western-most development of this moraine is near the village of Blue Ridge in northern Piatt County. From this point it extends in a south west direction until it crosses the Sangamon River a short distance north of the city of Mahomet. One half mile further southwest the moraine reappears and continues toward the southeast passing just west of the city of Champaign. A short distance west of the city of Champaign the outer or West Ridge branch of the moraine separates from the main belt and passes southward through Savoy and Tolono to West Ridge village in Douglas County; near which it swings eastward to join the middle ridge in Vermilion County. The main series of morainal hills swings to the east just as it enters the Urbana quadrangle, near Champaign passing through the University farm and the cemetery. Near the latter it turns again to the southeast leaving the quadrangle near the town of Philo, where it divides, one part continuing southeast and joins the outer ridge in Vermilion Co, and the inner ridge extending eastward almost parallel with the Wabash Railroad towards Fairmont.

A part of the Bloomington recessional moraine is to be seen in the extreme northeast corner of the quadrangle where it

occupies an area of about two square miles. In addition to the recessional moraines mentioned above there is a minor moraine extending north to Thomasboro from a point a short distance east of Urbana. This has been called a medial moraine, but that term is not appropriate for moraines of continental glaciers, this being a recessional moraine. With the exception of the small area in the northeast corner occupied by the Bloomington moraine, all of the other morainal ridges in the area were formed around the borders of the Champaign lobe of the early Wisconsin ice sheet.

MATERIALS OF THE RECESSIONAL MORAINES

The materials of the morainal ridges are usually very course. Beds of sand gravel and small boulders are interbedded with clay containing a large proportion of gravel. These sand and gravel beds may be met at any depth, and those encountered in one well may be absent from another only a few rods distant, being replaced by others at different levels. Such sand and gravel beds were deposited by streams and later were reworked by other streams as the conditions at the oscellating ice front changed, and were succeeded by others at higher levels as the materials accumulated.

THE GROUND MORAINE

The material of the till sheet between the recessional moraines is known as the ground moraine and was deposited as the ground glaciers were retreating northward at a rather uniform rate. Its constitutents are much finer than those in the morainal hills. This drift material is a rather uniformly compact, pebbly, blue clay, with no distinct sand and gravel horizons.

The pebbly clay is so dense and impervious that it confines the water in the lower sand beds and thus often makes artesian conditions possible. It also acts in the same way as an impervious cover confining the gas of the drift in the underlying porous sand-beds, producing conditions for local weak gas wells. The uniform spread of the drift over the level surface of the ground moraines indicates that the ice of the Wisconsin glaciation was rather evenly loaded with detritus. The level nature of the surface shows also that the recession of the ice sheet was at a rather uniform rate, between the long pauses during which the recessional morainic ridges were formed, since such a flat drift surface would be produced by the uniform recession of an evenly loaded ice sheet.

THE LOESS

With the exception of a few of the higher ridges on which erosion has been effective, the greater portion of the surface of the Wisconsin drift in this quadrangle is covered by a thin deposit of fine material called loess. Loess is intermediate in fineness between fine sand and clay. The color is usually light yellow or buff, but may be gray or dark brown. The deposits are ordinarily without stratification and only the lower few inches contain pebbles derived from the drift. In composition it is very much more calcareous than ordinary soil and frequently contains concretions of calcium carbonate. The material composing loess seems to have been derived from the drift with which it is associated, and microscopic examination shows it to be made up of pulverized rock and not of soil or decomposed rock material. The individual grains are characterized by irregular-

ity, being composed of such minerals as quartz, feldspar, hornblend, augite, magnetite, dolomite, and calcite. The deposits are thickest along the streams especially on the east and south banks, and they grow thinner at greater distances from the streams. The size of the individual grains of the loess also decrease with the increase of the distance from the stream valleys.

The Mode of Loess Deposition

The manner of deposition of the loess is one of the great problems of Pleistocene geology. Two views are held as to the mode of origin of this material. One that it is an aolian or wind deposit, and the other that it was laid down by water. It seems certain that the loess must be largely if not entirely of aolian origin. The much greater thickness of the loess near the streams, and especially upon the east and south sides, would indicate a close relation with the stream valleys as the source of the material, and winds as the agent of deposition. There are very great differences in the thickness and distribution of the loess found upon the Illinoian and that found upon the Wisconsin till sheets. The relation of the thicker deposits of loess to the larger stream valleys would suggest that during times of overflow extensive mud flats were formed the material of which after drying would be in excellent condition to be picked up and carried by the wind until some obstruction like the opposing banks would check the velocity of the wind current and cause the deposition of its load of dust.

It has also been suggested that during the period of Iowan glaciation the climate was very dry and the evaporation from the Iowa glacier was rapid and that large amounts of loose fine mater-

ials were liberated as the ice evaporated. This loose material was picked up fromthe ice surface by the winds and carried out to the border of the glacier where a large part of it was dropped rather quickly, forming the great loess hills that are found around what was then the border of the Iowan ice sheet. The great extent and thickness of the loess around the margin of the Iowan drift area indicates that conditions were unusually favorable for loess deposition during that period. The loess upon the Wisconsin till is probably less closely connected with the glacial conditions than that over parts of the Illinoian drift. The very much thinner deposits of loess on the Wisconsin drift were probably formed not so much by material picked up from the ice, as by that picked up by the winds from such land surfaces as stream flood plains, and deposited slowly through a long series of years. Consistent with this mode of loess accumulation the presence of pebbles in the lower part of the loess might be explained by burrowing animals which in making their burrows would mix some pebbly till with the loess until the thickness of the loess became too great for the burrows of such animals to reach the drift.

In the Urbana quadrangle the thickness of the loess varies from one to five feet. Usually it is very fine grained but in some places it is almost sandy in character. When unweathered it is light yellow or buff in color, but it is dark brown where weathering has been effective. The unweathered portion is calcareous and often contains concretions of calcium carbonate. The loess in this area does not have the excessive thickness along the east and south banks of streams that it does over the

Illinoian drift area.

PLEISTOCENE PONDS

After the Wisconsin or latest ice sheet withdrew from the region there were many depressions over the surface in which water collected, forming ponds in which extensive fresh water molluscan faunas developed. The shells of successive generations of these animals, mingled with the clay carried into the ponds by the winds or streams, often formed extensive beds of marl, some of which are three to five feet thick. Peaty material also collected in these shallow ponds or marshes. Southeast of Flatville the soil is very peaty and contains many marl concretions. About four miles east of Urbana peat deposits are common. On the University campus the site of such a pond now completely filled, was exposed in the excavation for the new green houses in the fall of 1912. Here was found gray marly material three to four feet thick with numerous concretions, and shells of many fresh water molluscs. Above the marly bed was a thickness of four to five feet of black peaty soil. The whole deposit having a thickness of seven to eight feet, was formed as the pond was filled by the slow accumulation of these materials.

WATER BEARING BEDS OF THE REGION

Within the Urbana quadrangle very few wells penetrate to bed rock and almost none derive their water from strata lower than the Pleistocene. Most of the wells penetrate the drift deposits a comparatively short distance; the surface wells being dug in the Wisconsin till, and the bored or driven wells being

put down to the upper part of the Illinoian till. An abundant water supply can always be obtained from the sand beds associated with the glacial deposits so there is little inducement to sink wells to greater depths.

THE WATER TABLE

The term water table or ground water surface refers to the level below which the ground or rock is saturated with water. The surface of the area is so flat that the water table is very near the surface over a large part of the quadrangle. Originally much of the land was swampy, but artificial drainage has lowered the ground water level sufficiently to make possible the cultivation of all of this land. The channel of the streams are so poorly developed that they influence the level of the ground water only in the immediate vicinity of the larger drainage lines.

THE MAIN WATER-BEARING SAND BEDS

Water-bearing sand beds are found at two main levels, both of which can be traced over the entire area of the quadrangle. The upper sand bed is the best known since it usually furnishes a sufficient supply of water. It occurs just below the Sangamon interglacial soil horizon, and therefore lies just above the deposits of the Illinoian ice sheet at a depth of 60 to 100 feet below the surface. In the north part of the area this upper sand is encountered at an altitude of about 630 feet above sea level, and in the southern part the elevation is about 600 feet, showing a southward slope of this sand bed of about 1.7 feet per mile. The southward slope of the water bearing sands and the

head or water pressure produced by the compact overlying till are the potent factors that control the hieght to which the water rises in the wells.

A large amount of data has been secured inthe well survey of the area, and since the upper sand has been so accurately located by these well records, it has been possible to construct a contour map showing its lay. The southward slope of the sand bed is apparently at a nearly uniform rate. The position of the lower sand bed is not so accurately located by the well records, since fewer wells penetrate it, but it appears to lie much more nearly horizontal than the upper one. In the north part of the area the two sand horizons are separated by an interval of 40 to 50 feet while in the south part the interval is from 10 to 20 feet. The upper sand bed is 12 to 25 feet thick, while the lower one is very much thicker in places reaching as much as 70 feet. Very few wells reach the bottom of this deposit, and hence information in regard to its total thickness is meagre. The material of these water bearing beds varies greatly from place to place. Sand may be found in one well, and a few rods away gravel may replace the sand at the same level. Usually however fine material is most abundant near the top and coarser sands or gravel at a lower level A white or nearly white sand, called quicksand, by the drillers, is common. This is very troublesome since it makes its way into the pumps through the sand screens and causes an excessive wearing of the pump parts, and often results in the complete choking or shutting off the water supply. In the quadrangle many wells have been abandoned because of the caving action of the very fine sand before or soon after being completed. On a number of farms

wells have been put down in three or four different places before the trouble from quicksand was overcome. The presence of quicksand rather than the lack of water in the higher horizon is often the cause of putting the well down to the second sand bed. In only a few wells do the drillers find gravel; sand and clay being the only materials generally penetrated. The sand is light colored, often almost white and composed largely of quartz grains.

Just above the upper sand occurs the Sangamon soil horizon, or peat deposit, and above this lie the deposits left by the Wisconsin ice sheet. The Wisconsin drift is very much less sandy than the Illinoian, and is composed for the most part of a rather uniform compact, bluish-gray, pebbly clay. The only variation from this material is in the morainal ridges in which there are numerous gravel deposits of small extent that furnish a good water supply. These gravel beds may occur at any level in the Wisconsin morainal ridges and there is little uniformity in the depth at which they are encountered. A few characteristic well records showing the relation of the sand beds to the Pleistocene deposits are given below.

Section in Boring at Champaign Illinois -

	Ft.
Black soil	4
Yellow and blue clay	44
Quicksand	12
Gravel	7
Blue clay	35

	Ft.
Quicksand	71
Gravel	6
Hardpan	5
Sand	11
Hardpan	51
Total	253

Section in Well at the University.

	Ft.
Black soil	3
Pebbly clay	62
Very fine grayish brown material free from pebbles (probably Iowan loess)	6
Sandy peat	3
Coarse sand	16
Gravel	5
Coarse gravel	8
Pebbly clay	7
Sand	15
Total passed through	130

Section Four Miles South of Champaign

	Ft.
Black soil	4
Pebbly clay	75
Dark soil	1
Sand (with gas)	4
Pebbly clay	11
White sand	6
Total passed through	101

ARTESIAN CONDITIONS

The bed of sand sloping towards the south, with a bed of till more or less impervious to water above and below it furnishes the conditions necessary for the production of artesian wells. Artesian conditions are found over all of the northeast and parts of the southeast quarters of the quadrangle. Water rises to within six feet of the surface over the most of the level portion of the area from Flatville south through Stanton Township. Along the lower six miles of the course of Spoon River flowing wells are common as indicated upon a map of the area

CONTOUR MAP OF THE UPPER SAND BED

The contour map of the level of the water table of the area has been constructed on the levels of the water in the different wells. The drilled wells have furnished the greater part of the data, both as to accuracy and quantity of information. In the west part of the area the water in such drilled wells often falls below the level of the water table. This condition is caused by the impervious clay bed through which water does not readily percolate, that allows the collection of surface water above it, and the lack of sufficient water head in the sand beds below to raise this water to a level with the upper water table. In the east part of the area the reverse is true, since here the impervious beds below and above confine the water and the southward slope of the sand bed gives a head that lifts the water from this source above the upper water table and in some cases above the surface. For this reason the map does not represent ground water levels, which may vary quite widely from that in the wells. The highest level at which water is found in the wells

of the quadrangle is in a belt running nearly north and south just north of Champaign at an elevation of about 710 feet. The water level contour lines extend in a more or less north and south direction and there is a gradual decline towards the east. This eastward fall or slope of the water table is not so great as the eastward slope of the land surface and correspondingly the water comes closer to the surface, or may even overflow the wells in the eastern part of the area. The lowest water levels are found along the course of Salt Fork near where it leaves the area three and one half mile north of the southeast corner of the quadrangle. Here the water level is about 640 feet above the sea and corresponds to the water level in Salt Fork, which in the vicinity of the river controls the ground water level. Southeast of Urbana the contour lines can be seen to turn south as they cross Yankee Ridge, below which there is a distinct rise in the water level.

NATURAL GAS IN THE AREA

A porous bed with a compact clay deposit above and below is favorable for the accumulation of gas as well as water. Within this area there are large amounts of buried vegetable matter derived from the peat deposits of the Sangamon soil horizon. The porous sand bed furnishes a reservoir for the gas and the impervious clay prevents its escape. As the peaty material slowly decays without access of air, hydrocarbons, as natural gas are produced and accumulate in the sand beds. Natural gas deposits are reported from a large number of the wells of the area and a few farmers have piped the gas to their houses and

used it for lighting purposes. There is a local belief that the gas comes from the rocks and thus indicates the probability of oil in the rocks at greater depths in this region, but it seems clear that the Pleistocene deposits are the only source of this gas. All of the materials and all of the conditions for its accumulation are supplied by the Pleistocene deposits and wells sunk into the rock in this region show no trace of oil or gas. These facts furnish additional proof of the now generally accepted theory that oil and gas are of organic origin. The wells where gas is secured in sufficient amounts to be used for house lighting have been indicated on Plate IV.

DESCRIPTION OF THE TOPOGRAPH

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PLATE II

TOPOGRAPHY

H M Wilson Geographer in charge of section
Chas E Cooke, Topography by Albert Pike
Control by U S Lake Survey and J R Ellis
Surveyed in 1905

SURVEYED IN COOPERATION WITH THE STATE OF ILLINOIS

Contour interval 10 feet
Datum is mean sea level

WATER LEVEL CONTOURS

Contou interval 10 Ft

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The features shown on this map may, for convenience of description, be classified in three groups, as follows: (1) *relief*, including mountains, hills, valleys, cliffs, etc.; (2) *culture*, i. e., works of man, such as towns, cities, roads, railroads, boundaries, etc. The conventional signs used for these features are grouped below. Variations appear in some maps of earlier dates.

All water features are shown in *blue*, the smaller streams and canals in full blue lines, and the larger streams, lakes, and the sea by blue water-lining. Certain streams, however, which flow during only a part of the year, their beds being dry at other times, are shown, not by lines, but by lines of dots and dashes. Lakes which are dry during a part of the year are shown by oblique parallel lines. Salt-water marshes are shown by horizontal ruling interspersed with tufts of blue, and fresh-water marshes and swamps by blue tufts with broken horizontal lines.

Relief is shown by *brown* contour lines. Each contour passes through points which have the same altitude. A contour on the ground will go neither uphill nor downhill, but on a level. By the use of contours not only are the shapes of the hills, and mountains shown, but also the steepness. The line of the seacoast itself is a contour line, the datum or zero of elevation being mean sea level. The contour line at, say, 20 feet above sea level is the line that would be the seacoast if the sea were to rise 20 feet. Such a line runs back up the valleys and forward and the points of hills and spurs. On a gentle slope this contour line is far from the present contour line, while on a steep slope it is near it. The succession of these contour lines far apart or close together on the map indicates a gentle slope or a steep slope; and if the contours run together in a single line, as if each were vertically under the other, they indicate a cliff. In many parts of the country are depressions or hollows with no outlet. The contours of course surround these, just as they surround hills. Those small hollows known as sinks are usually indicated by hachures, or short lines on the inside of the curve. The contour interval, or the vertical distance in feet between one contour and the next, is stated at the bottom of each map. The interval may be 10 feet, in a mountainous country it may be 20 feet. Certain contours, usually every fifth one, are accompanied by figures giving elevation above sea level. The heights of many definite points, such as road corners, railroad crossings, railroad stations, summits, water surfaces, triangulation stations, and bench marks, are also given. The figures in each case are placed close to the point to which they apply, and express the elevation to the nearest foot only. The *exact* elevations of bench marks and their descriptions, as well as the descriptions and geodetic coordinates of triangulation stations, are published in the annual reports and bulletins of the Survey. The publications pertaining to specified localities may be had on application.

The works of man are shown in *black* in which color all lettering also is printed. Boundaries, such as State, county, city, land-grant, reservation, etc., are shown by broken lines of different kinds and weights. Cities are indicated by black blocks, representing the built-up portions, and country houses by small black squares. Roads are shown by fine double lines (full for the better roads, dotted for the inferior ones), trails by single dotted lines, and railroads by full black lines with cross lines. Other cultural features are represented by conventions which are easily understood.

The sheets composing the topographic atlas are designated by the name of a principal town or of some prominent natural feature within the district, and the names of adjoining published sheets are printed on the margins. The sheets are sold at five cents each when fewer than 100 copies are purchased, but when they are ordered in lots of 100 or more copies, whether of the same sheet or of different sheets, the price is three cents each.

The topographic map is the base on which the facts of geology and the mineral resources of a quadrangle are represented. The topographic and geologic maps of a quadrangle are finally bound together, accompanied by a description of the district, to form a folio of the Geologic Atlas of the United States. The folios are sold at twenty-five cents each, except such as are unusually comprehensive, which are priced accordingly.

[illegible] or folios of the Geologic Atlas should be accompanied by cash or money order (not postage stamps), and should be addressed to—

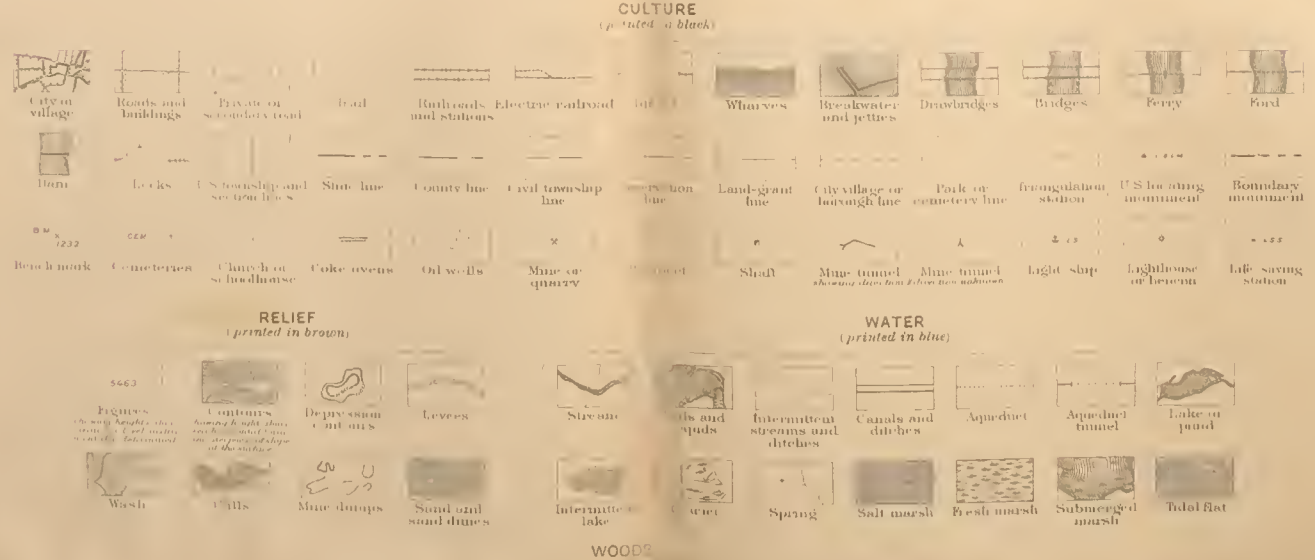
THE DIRECTOR,

United States Geological Survey,

Washington, D. C.

July, 1905.

CONVENTIONAL SIGNS



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Applications for the separate topographic maps

DESCRIPTION OF THE TOPOGRAPHIC

The United States Geological Survey is making a topographic map of the United States. This work has been in progress since 1882, and about three-tenths of the area of the country, excluding outlying possessions, has been mapped. The mapped areas are widely scattered, nearly every State being represented, as shown on the progress map accompanying each annual report of the Director.

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The features shown on this map may, for convenience, be classed in three groups: (1) *water*, including [illegible] lakes, ponds, rivers and other [illegible] times, are shown, not by dots and dashes. Ponds part of the year are [illegible] lines. Salt-water marshes ruling interspersed with water marshes and [illegible] broken horizontal lines.

Relief is shown by [illegible]. Each contour passes through the same altitude. One [illegible] the ground will go around [illegible] but on a level. By [illegible] are the shapes of the [illegible] shown, but also the slope. [illegible] seacoast itself is a contour [illegible] of elevation being mean [illegible] line at, say, 20 feet above [illegible] would be the seacoast if the land to sink 20 feet. [illegible] the valleys and forward [illegible] and spurs. On a gentle [illegible] far from the present [illegible] shown it is near it. Contour lines far apart [illegible] slope; if close together, [illegible] contours run together [illegible] vertically under the [illegible] cliff. In many parts of [illegible] or hollows with no outlet [illegible] surround these, just as [illegible] small hollows known as [illegible] by hachures, or short [illegible] curve. The contour [illegible] tance in feet between [illegible] stated in the history [illegible] varies according to [illegible]

PLATE III

SURVEYED IN COOPERATION WITH THE STATE OF ILLINOIS

SAND BED ELEVATIONS AND CONTOURS OF UPPER SAND BED

DESCRIPTION OF THE TOPOGRAPHIC MAP OF THE UNITED STATES

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The finished maps, being published on sheets of convenient size, are bounded by parallels and meridians. The topography is represented by contours and by conventional signs. The sheets show the features existing at the time the surveys were made. By means of the contours the exact height, form, and slope of the ground are represented. Bench marks are established at frequent intervals, and the elevation of these is given on the maps. Lines of levels have been run to establish the altitudes of a sufficient number of points in each area to serve as a basis for the contours and bench marks shown on the map. The datum plane to which the elevations refer is mean sea level. In the case of lakes, the elevation given is that of the surface of the water at the time the shore line was surveyed. In the case of rivers, the elevation is that of the water surface at the time the adjacent topography was surveyed. Elevations in mines and other underground workings are based on surface bench marks connected with the underground workings by accurate surveys.

The area of each map sheet is bounded by parallels and meridians, and the intervening space is filled with the topography and the culture. The boundaries of the sheets are so chosen that the lines will run through conspicuous points in the topography, such as the confluence of streams, the intersection of roads, or the corners of cultivated fields. The sheets are designated by the names of prominent cities or villages within the limits of the mapped area, or by the names of conspicuous features, such as rivers, lakes, mountains, or valleys.

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The topographic maps of the East on which the geology and the mineral resources of a portion of the area are represented. The topographic and geologic maps of each reference are finally bound together and accompanied by a description of the district covered. A set of these Geologic Atlas of the United States. The folios are sold at twenty-five cents each

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PLATE IV

H M W L Geographer
Chas E Cooke in charge of section
Topography by Albert Pike
Control by S Lake Survey and R E H
1904 and 1905

SURVEYED IN COOPERATION WITH THE STATE OF ILLINOIS

DESCRIPTION OF THE TOPOGRAPHIC MAP OF THE UNITED STATES

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This great map is being published in atlas sheets of convenient size, which are bounded by parallels and meridians. The four-cornered division of land corresponding to an atlas sheet is called a *quadrangle*. The sheets are of approximately the same size: the paper dimensions are 20 by 16½ inches, the map occupying about 17½ inches of height and 11½ to 16 inches of width, the latter varying with latitude. Three scales, however, are employed. The largest scale is 1:62500, or very nearly one mile to one inch; i. e., one linear mile on the ground is represented by one linear inch on the map. This scale is used for the thickly settled or industrially important parts of the country. For the greater part of the country an intermediate scale of 1:125000, or about two miles to one inch, is employed. A third and still smaller scale of 1:250000, or about four miles to one inch, has been used in the desert regions of the far West. A few special maps on larger scales are made of limited areas in mining districts. The sheets on the largest scale cover 15′ of latitude by 15′ of longitude; those on the intermediate scale, 30′ of latitude by 30′ of longitude; and those on the smallest scale, 1° of latitude by 1° of longitude.

The features shown on the map may, for convenience, be classed in three groups: (1) *water*, [illegible] streams, canals, swamps, etc., (2) *relief*, including mountains, hills, valleys, cliffs, etc.; (3) *culture*, i. e., works of man, such as towns, cities, roads, railroads, boundaries, etc. The conventional signs used for these features are grouped below. Variations appear in some maps of earlier dates.

All water features are shown in *blue*, the smaller streams and canals in full blue lines, and the larger streams, lakes, and the sea by blue water-lining. Certain streams, however, which flow during only a part of the year, their beds being dry at other [illegible] are shown, not by full lines, but by lines of dots and dashes. Ponds which are dry during a part of the year are shown by oblique parallel lines. Salt-water marshes are shown by horizontal ruling interspersed with tufts of blue, and fresh-water marshes and swamps by blue tufts with broken horizontal lines.

Relief is shown by *contour lines* in *brown*. Each contour passes through points which have the same altitude. One who follows a contour on the ground will go neither uphill nor downhill, but on a level. By the use of contours not only are the shapes of the plains, hills, and mountains shown, but also the elevations. The line of the seacoast itself is a contour line, the datum or zero of elevation being mean sea level. The contour line at, say, 20 feet above sea level is the line that would be the seacoast if the sea were to rise or the land to sink 20 feet. Such a line runs back up the valleys and forward around the points of hills and spurs. On a gentle slope this contour line is far from the present coast line, while on a steep slope it is near it. Thus a succession of these contour lines far apart on the map indicates a gentle slope, if close together a steep slope; and if the contours run together in one line, as if each were vertically under the one above it, they indicate a cliff. In many parts of the country are depressions or hollows with no outlets. The contours of course surround these, just as they surround hills. Those small hollows known as sinks are usually indicated by hachures, or short dashes, on the inside of the curve. The contour interval, or the vertical distance in feet between one contour and the next, is stated at the [illegible]. The interval [illegible] the character of the [illegible] mapped; in a [illegible] be as small as 10 feet, in a mountainous [illegible] may be 200 feet. [illegible] only every fifth one, are [illegible] figures stating elevation above sea level. [illegible] heights of many definite points, such as road corners, railroad crossings, railroad stations, summits, water surfaces, triangulation stations, and bench marks, are also given. The figures in each case are placed close to the point to which they apply, and express the elevation to the nearest foot only. The *exact* elevations of bench marks and their descriptions, as well as the descriptions and geodetic coordinates of triangulation stations, are published in the annual reports and bulletins of the Survey. The publications pertaining to specified localities may be had on application.

The works of man are shown in *black*, in which color all lettering also is printed. Boundaries such as State, county, city, land-grant, reservation, etc., are shown by broken lines of different kinds and weight. Cities are indicated by black blocks, representing the built-up portions, and country houses by small black squares. Roads are shown by fine double lines (full for the better roads, dotted for the inferior ones), trails by single dotted lines, and railroads by full black lines with cross lines. Other cultural features are represented by conventional signs which are easily understood.

The sheets composing the topographic atlas are designated by the name of a principal town or of some prominent natural feature within the district, and the names of adjoining published sheets are printed on the margins. The sheets are sold at five cents each when fewer than 100 copies are purchased, but when they are ordered in lots of 100 or more copies, whether of the same sheet or of different sheets, the price is three cents each.

The topographic maps, the base on which the facts of geology and the mineral resources of a quadrangle are represented. The topographic and geologic maps of a quadrangle are finally bound together, accompanied by a description of the district, to form a folio of the Geologic Atlas of the United States. The folios are sold at twenty-five cents each, except such as are unusually comprehensive, which are priced accordingly.

Applications for the separate topographic maps or for folios of the Geologic Atlas should be accompanied by the cash or by post-office money order (not postage stamps), and should be addressed to—

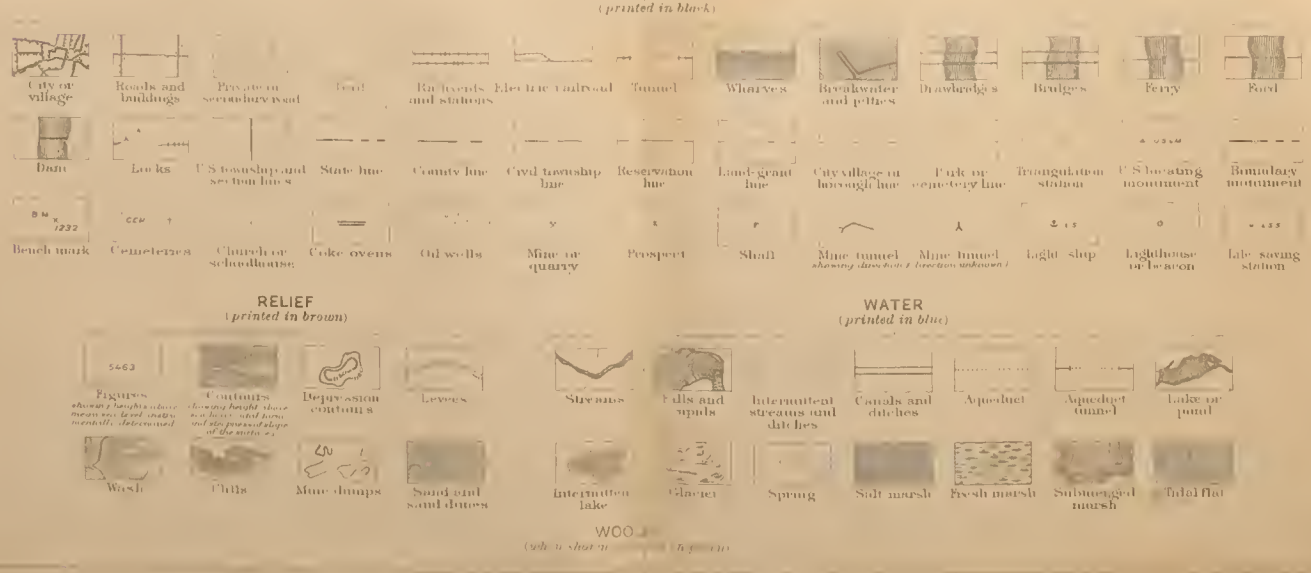
THE DIRECTOR,

United States Geological Survey,

Washington, D. C.

July, 1905.

CONVENTIONAL SIGNS



HIC MAP OF THE UNITED STATES

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Applications for the separate topographic maps

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